

CLAIMS

What is claimed:

1. A wafer processing apparatus comprising:

a processing chamber defined by a lower wall, an upper wall and side walls extending from the lower wall to the upper wall, a wafer supply opening being formed in one of the walls for transferring a wafer into the chamber, and the upper wall having a plurality of gas supply openings, each formed into an upper surface and out of a lower surface thereof;

a susceptor in the chamber on which the wafer can be located so that an upper surface of the wafer faces the upper wall;

a manifold component located on the chamber and, together with the upper surface of the upper wall, defining a manifold cavity;

a gas supply line connected to the manifold component, a gas, when flowing in the gas supply line, flowing from the gas supply line into the manifold cavity and from the manifold cavity through the gas supply openings into the chamber so that the wafer is exposed to the gas, lower ends of at least some of the openings extending at an angle other than at right angles relative to the upper surface of the wafer so that the gas, when exiting the openings flows at an angle other than at right angles relative to the upper surface, a flow pattern created by flow from the openings promoting even processing over the upper surface of the wafer; and

an exhaust line connected to the gas chamber, the gas flowing from the

chamber through the exhaust line.

2. The apparatus of claim 1 wherein, when viewed from above, at least some of the openings each have a lower end which is displaced relative to an upper end thereof.

3. The apparatus of claim 2 wherein there are first and second ones of the openings on opposing sides of a point on the upper wall, the first opening having a lower end which is angularly displaced relative to an upper end thereof in a selected direction about the point, and the second opening having a lower end which is angularly displaced relative to an upper end thereof in the selected direction, so that the openings jointly created a circular flow pattern in the chamber.

4. The apparatus of claim 3 wherein flow of the gas in the chamber is laminar.

5. The apparatus of claim 2 wherein there are first and second ones of the openings, the first opening having a lower end which is displaced in a first direction relative to an upper end thereof, and the second opening having a lower end which is displaced in a second, opposing direction relative to an upper end thereof.

6. The apparatus of claim 5 wherein flow of the gas in the chamber is turbulent.
7. The apparatus of claim 5 wherein a third of the openings, on a side of the second opening opposing the first opening, has a lower end which is displaced in the first direction relative to an upper end thereof.
8. The apparatus of claim 7 wherein the flow is turbulent.
9. The apparatus of claim 1 wherein the exhaust line is connected at an exhaust location which is off-center with respect to a center point of the wafer, when viewed from above, so that the gas exits out of the wafer at the exhaust location which is off-center with respect to a center point of the wafer.
10. The apparatus of claim 9 wherein a channel is defined within the chamber, the channel being concentric with the wafer, gas flowing radially outwardly over the wafer into the channel, and from the channel to the exhaust location and into the exhaust line.
11. The apparatus of claim 10 wherein the openings are formed to increase a flowrate of the gas over the wafer farther from the exhaust location.
12. A wafer processing apparatus, comprising:

a processing chamber defined by a lower wall, an upper wall and side walls extending from the lower wall to the upper wall, a wafer supply opening being formed in one of the walls for transferring a wafer into the chamber, and the upper surface and out of a lower surface thereof;

a susceptor in the chamber on which the wafer can be located so that an upper surface of the wafer faces the upper wall;

a manifold component located on the chamber and, together with the upper surface of the upper wall, defining a manifold cavity;

a gas supply line connected to the manifold component, a gas, when flowing in the gas supply line, flowing from the gas supply line into the manifold cavity and from the manifold cavity through the gas supply openings into the chamber so that the wafer is exposed to the gas, the gas supply openings being nonuniformly distributed over the upper wall so that the gas, after leaving the gas supply openings, creates a flow pattern that promotes even processing over the upper surface of the wafer; and

an exhaust line connected to the gas chamber, the gas flowing from the chamber through the exhaust line.

13. The apparatus of claim 12 wherein the openings are more densely located on one side of the upper wall than on another side thereof.

14. The apparatus of claim 13 wherein the openings are substantially equal in size.

15. The apparatus of claim 12 wherein flow of gas in the chamber is laminar.

16. The apparatus of claim 12 wherein the exhaust line is connected at an exhaust location which is off-center with respect to a center point of the wafer, when viewed from above, so that the gas exits out of the chamber at the exhaust location which is off-center with respect to a center point of the wafer.

17. The apparatus of claim 16 wherein a channel is defined within the chamber, the channel being concentric with the wafer, gas flowing radially outwardly over the wafer into the channel, from the channel, to the exhaust location into the exhaust line.

18. The apparatus of claim 17 wherein the openings are more densely located farther from the exhaust location.

19. A wafer processing apparatus, comprising:

a processing chamber defined by a lower wall, an upper wall and side walls extending from the lower wall to the upper wall, a wafer supply opening being formed in one of the walls for transferring a wafer into the chamber, and the upper wall having a plurality of gas supply openings, each formed into an upper surface and out of a lower surface thereof;

a susceptor in the chamber on which the wafer can be located so that an upper surface of the wafer faces the upper wall;

a manifold component located on the chamber and, together with the upper surface of the upper wall, defining a manifold cavity;

a gas supply line connected to the manifold component; and

an exhaust line connected to the chamber, a gas, when flowing in the gas supply line, flowing from the gas supply line into the manifold cavity and from the manifold cavity through the gas supply openings into the chamber so that the wafer is exposed to the gas, the gas flowing from the chamber through the exhaust line, the exhaust line being connected to the chamber at an exhaust location off-center with respect to a center point of the wafer so that flow over the wafer closest to the exhaust location tends to be faster than over an area of the wafer farther from the exhaust location if the gas supply openings are uniformly spaced and entirely vertical, the gas supply openings being formed so as to reduce the tendency for the flow to be faster over the wafer closest to the exhaust location than at the location farther from the exhaust location so as to promote even processing of the wafer.

20. The apparatus of claim 19 wherein a channel is defined within the chamber, the channel being concentric with the wafer, gas flowing radially outwardly over the wafer into the channel, from the channel, to the exhaust location into the exhaust line.